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Four Intertidal Species of The Genus *Melita* (Crustacea: Amphipoda) from Japanese Waters, Inculding Descriptions of Two New Species[1)]

By

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With Text-figures 1–20

Abstract Four intertidal species of the genus *Melita* (sensu Karaman, 1981) are described mainly from the Seto Inland Sea of Japan, of which two are new species, *Melita nagatai* and *Melita bingoensis*. Two species, *Melita rylovae* Bulycheva and *M. koreana* Stephensen, of which the former was regarded as a synonym of *M. koreana* by Nagata (1965), are redescribed here as separate species. These four species are closely related, but they are clearly discriminated by the shape of male gnathopod 1 and female "hooked" coxa 6.

Although the genus *Melita* was formerly an extremely large genus, in which about 70 species had been accommodated, it is now separated into *Melita* (s. str.), *Dulichiella*, *Abludomelita*, and some monotypic genera (Karaman & Barnard 1979, Karaman 1981, Barnard & Karaman 1982, Stock 1985; see also Barnard & Barnard 1983, for "melitids", tentative grouping of related genera by them). In addition to such generic readjustments, there is a tendency to split species which are formerly recognized as a single species or a complex of false synonyms (for example, *Melita* "*nitida* complex": see Sheridan, 1979; *Melita inaequistylis* (Dana, 1852): see Barnard, 1972b). Although the taxonomy of melitids seems to be highly improved, there is little doubt that many problems remain unresolved. Taxonomic treatment of *M. koreana* Stephensen and *M. rylovae* Bulycheva by Nagata (1965), who regards them as a single species, is the case in point. In fact, I primarily intended a survey of melitid amphipods in Japan in order to reconsider this problem, and during the course of this survey I have found that many undescribed species and problematic ones were still present in this group. The result of this survey will be reported in a series of papers, and as the first report the present paper deals with four species of the genus *Melita*, namely, *M. rylovae*, *M. koreana*, and two new species.

Descriptions are mainly based upon the specimens from the intertidal zone at the front beach of the Mukaishima Marine Biological Station (34°22′N, 133°13′E) in the Seto Inland Sea of Japan,

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where these four species are very common under stones and occur sympatrically. Although I have examined thousands of specimens from that beach in various seasons, only the specimens selected for type series and for figures are indicated in the "material examined", mentioned before the description of each species. Specimens used for the figures of each species are numbered, like Male (1). Specimens from localities outside the Seto Inland Sea of Japan are also included in it as distributional records. Typical habitats of each species are indicated, based upon the observation around the Mukaishima Marine Biological Station. The type series are deposited at the Mukaishima Marine Biological station.

Abbreviations. R., right; L., left; A, antenna 1, 2; CS, coupling spine of pleopods 1–3; CX, coxa 1–7; E, epimeral plate 1–3; G, gnathopod 1, 2; GI, gill 2–6; IP, inner plate; LL, lower lip; MD, mandible; MX, maxilla 1,2; MXP, maxilliped; OP, outer plate; OS, oostegite; PA, palp; PL, pleopod 1–3; PLS, pleosomite 1–3; PR, pereopod 3–7; T, telson; U, uropod 1–3; UL, upper lip; URS, urosomite 1–3; f, female; i, inner surface; c, outer surface; d, dorsal surface; v, ventral surface.

Summarization of identical characteristics in the four species

Because the species reported in this paper strongly resemble one another and are different only in a few characters, characteristics identical in the four species are summarized prior to the description of each species. Although these identical characteristics will not be mentioned again in the descriptions of each species, they are applicable to all the four species.

Males.

Body: Head with minute rostrum; lateral cephalic lobes subrounded, with slit, forming accessory lobes ventrally; eyes oval, slightly reniform. Pleonal segments without medial dorsal teeth.

Antenna 1: Peduncular article 1 robust, with some ventral spines and one distal long spine; peduncular article 2 elongate, longer than peduncular article 1; peduncular article 3 short, without spines.

Antenna 2: Slightly more robust than antenna 1; antennal gland cone acute triangular, with one small triangular projection at dorsal side of inner surface; peduncular article 3 with spines at ventro-terminal, at apex of round projection on inner surface, and on inner surface; peduncular articles 4 and 5 subequal in length; flagellum setose, with thin spiniform setae along dorsal margin.

Upper lip almost hexagonal, tapered and truncated distally, bristled along apical margin. Lower lip with moderately developed inner lobe, setaceous and bristled.

Mandible: Incisor with five teeth; lacinia mobilis with four teeth (left) and tri-lobed (right); spine row composed of up to 8 pectinate blades; molar well developed, with a longitudinal ridge extending to basal part of palp, its cutting surface asymmetrical, subround (left) and subrectangular (right), bearing one pinnate seta and two small lateral plates. Palp tri-articulate; first article short, without projections and setae; second article with some short setae only along ventral margin; third article as long as second article, non-falciform, with setae along dorsal and ventral margins and at apex; apical setae longest.

Maxilla 1: Inner plate quadrate, with some plumose terminal setae. Outer plate with 9 spines, which are bifurcate or multidentate. Palp bi-articulate; second article dilated, with thin subterminal spines on ventral surface; terminal margin

asymmetrical with tooth-like triangular projections (right) and thin spines (left).

Maxilla 2: Both plates with two rows of numerous terminal setae; inner plate with some pectinate lateral setae and short simple setae, lacking dorsal oblique row of setae.

Maxilliped: Inner plate folding back dorsally, with terminal and subterminal spines, and with a row of lateral and terminal plumose setae on dorsal surface and some simple terminal setae on ventral surface. Outer plate setaceous on medial part of ventral surface, with a row of spatulate spines along medial margin to terminal; those spatulate spines successively increasing length distally; distal spines plumose. Palp 4-articulate, with setae on ventral surface and along medial margin; article 3 slightly dilated, setulose anterodistally, with some pectinate spines on ventral surface and many long setae; article 4 nailed, setulose on dorsal surface, with some setae along inner margin and at basal part of nail.

Coxae 1–4 successively increasing length; ventral margin subround, with minute setae, with no projections. Coxa 1 slightly dilated distally; coxa 4 slightly lobed posterodistally. Coxae 5 and 6 with one round anterior lobe; coxa 7 unlobed.

Coxal gills 2–6 round, simple; coxal gill 2 slightly smaller than coxal gill 3; coxal gills 3–6 successively decreasing their size.

Gnathopod 1: Article 2 with numerous long setae along anterior margin and some long setae along posterior margin; article 3 short; article 4 quadrate, setulose on posterior side; article 5 long, setaceous on inner surface, with groups of one long simple seta and some pectinate setae along posterior mragin, lobed and setulose on anterodistal part, which bears some pectinate spines. Complex of articles 6 and 7, "aberrant form". Article 6 lobed anterodistally, excavated at basal part of palm on inner surface; palmar margin short, transverse, with bifurcated thin terminal spines and minute subterminal setae; posterior margin with groups of simple and pectinate setae. Dactyl short, bulged basally, attached at middle of anterodistal lobe of article 6, nailed apically, with one seta on outer margin and several setae at basal part of nail.

Gnathopod 2: Article 2 with long setae along posterior margin and short setae along anterior margin; article 3 short; article 4 short, posterodistally acutiform; article 5 short, cup-shaped, with numerous setules along posterior margin. Article 6 trapezoidal, slightly expanded distally; inner surface covered with numerous fine long setae, forming a channel filled with plumose setae; outer surface with no armature; posterior margin with groups of simple and pectinate setae; palmar margin with thin spines and long setae, and with no tubercles. Dactyl stout, overriding on article 6, with one short seta on outer margin, and with indistinct obtuse nail, which bears triangular process at basal part.

Pereopods 3 and 4 similar to each other; pereopod 4 slightly shorter than pereopod 3. Article 2 of pereopods 3–4 recurved, with long setae along posterior and anterior margins; article 3 short; articles 4–6 linear; article 4 with some spines along anterior margin and short setae along posterior margin; articles 5–6 with short spines along posterior margin, intermixed with short setae; dactyl simple, without process,

nailed apically, with some simple setae subapically and one plumose seta on outer margin.

Pereopods 5–7 similar to one another; pereopod 5 shorter than pereopods 6 and 7. Article 2 of pereopods 5–7 ovoid, lobate posteriorly, with very minute setae along posterior margin and spines along anterior margin; article 3 short; articles 4–6 linear, with numerous groups of spines; dactyl as in pereopods 3 and 4.

Pleopods 1–3: Pleopods 1 and 2 similar to each other; each peduncle with 2 coupling spines and one short seta on subapical part. Pleopod 3 slightly shorter than pleopods 1 and 2; peduncle with two coupling spines and one long spine, more setose than pleopods 1 and 2. Basal article of each inner ramus, with bifurcate plumose setae on medial margin.

Uropods 1 and 2: Spinose along dorsal margins of peduncles as well as both rami and at apices of rami. Peduncle of uropod 1 with one ventrofacial spine and one long distolateral spine.

Uropod 3: Peduncle shorter than outer ramus, with spines on outer surface, on dorsal surface, and at apical part. Inner ramus short, scale-like, with some subapical spines. Outer ramus elongate, with groups of spines along both outer and medial margins and at apex.

Telson: Incised to base. Each lobe pointed apically.

Females.

Smaller than males. Some structures are somewhat different from counterparts in males, probably due to the smaller body size; for example, less number of articles of antennae and less spination of each of appendages.

Gnathopod 1: Articles 2–4 as in males; article 5 shorter than in males. Article 6 quadrate, not lobed at anterodistal part, not excavated on inner surface. Dactyl not bulging basally.

Gnathopod 2: Remarkably smaller than in males; article 5 more elongated than in males. Article 6 ovoid; palmar margin oblique, with one row of short spines, one row of minute setae, and two strong spines at palmar corner. Dactyl nailed, with one seta on anterior margin, subapical setae, and very minute setae on outer surface.

Pereopods 5–7: Article 2 slightly narrowing posterodistally. Anterior lobe of coxa 6 elongated, "hooked", with swollen projection subapically.

Brood plates 2–5 narrow, with long setae.

Melita rylovae Bulycheva, 1955

(Japanese name: futomerita yokoebi, new)

(Figs 1–6)

Melita rylovae Bulycheva, 1955, pp. 201–204, fig. 5.
Melita koreana: Nagata, 1965, pp. 292–293 (part).
Abludomelita rylovae: G.S. Karaman, 1981, p. 40.

Material examined. Male (1), 7.3 mm; male (2), 7.5 mm; and female (1), 6.7 mm (ovigerous).

6 Oct. 1983, near the MLWS of intertidal zone, under stones, at the front beach of Mukaishima Mar. Biol. St. Male (3), 11.7 mm and female (2), 9.8 mm (ovigerous), 17 May 1984, from the same locality as above.

Two males, one ovigerous female and several juveniles, from the front beach of Amakusa Mar. Biol. Lab., Kyushu University, by Mr. S. Nishihama and Miss C. Aryuthaka, 20 Dec. 1984. One female from Kikonai, Hokkaido, 28 Apr. 1983, one female from Oshoro, Hokkaido, 28 Feb. 1984, one male from Oshoro, 30 May 1982, by Mr. S. Ishimaru.

Male.

Body (Fig. 1): Dorsal side of pleosomites 2 and 3 with arch-shaped submedial teeth on each side; in larger specimens also pleosomite 1 with submedial teeth. Urosomites 1 and 3 smooth; dorsal side of urosomite 2 with a distinct tooth on each side, which bears spines medially. Epimeral plates 1–2 slightly produced ventrodistally. Epimeral plate 3 strongly extended backward, acute ventrodistally. Epimeral plates 2 and 3 with spines along ventral margin.

Antenna 1 (Fig. 6–A1): Peduncular article 2 with groups of a spine and setae along ventral margin, groups of setae along dorsal margin; main flagellum up to ca. 40 articles; accessory flagellum up to 5-articles. Antenna 2 (Fig. 6–A2): Peduncular articles 4 and 5 with groups of spines and setae on inner surface and along dorsal and ventral margins in the most spinose specimen (Male (3)); in the other specimens ventral margin of peduncular article 5 without spines; flagellum up to ca. 15 articles. Maxilla 1 (Fig. 2–MX1): First article of palp without lateral setae; second article strongly dilated.

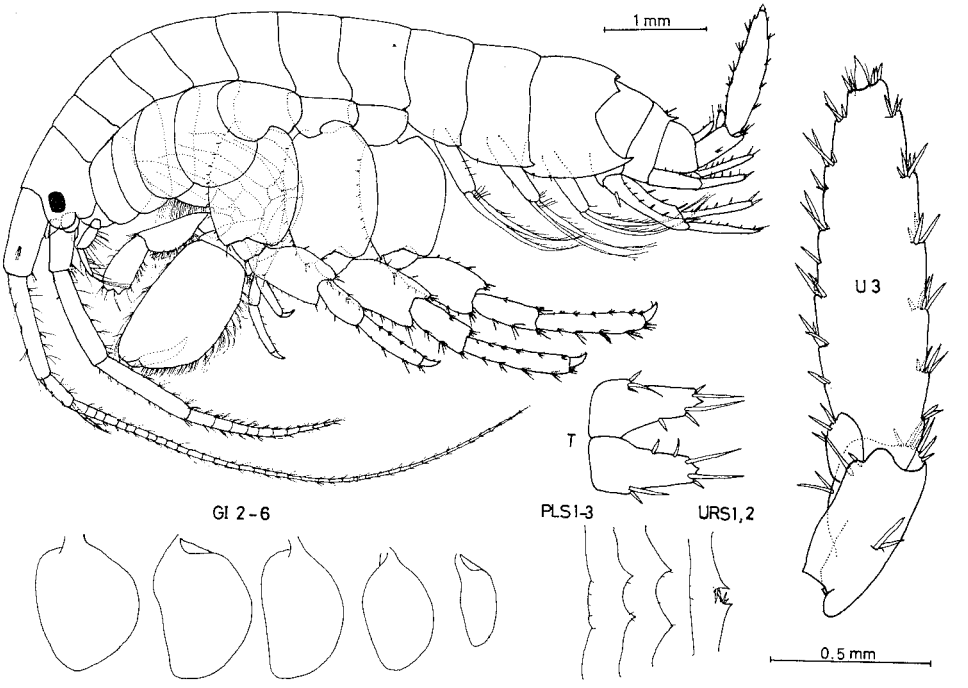

Fig. 1. *Melita rylovae* Bulycheva. Male (1).

Gnathopod 1 (Figs 3–G1, 6–G1): Article 6 with quadrate anterodistal lobe, which bears two tubercles on dorsodistal part, and broadly excavated on inner surface; palmar margin with two to five stout spines on inner surface. Gnathopod 2 (Fig. 3–G2): Palmar spines composed of short and long ones, bending onto inner side. Pereopods 5–7 (Fig. 5–PR6): Article 4 very robust, strongly spinated.

Uropod 3 (Fig. 1–U3): Outer ramus broad, bi-articulate; second article short

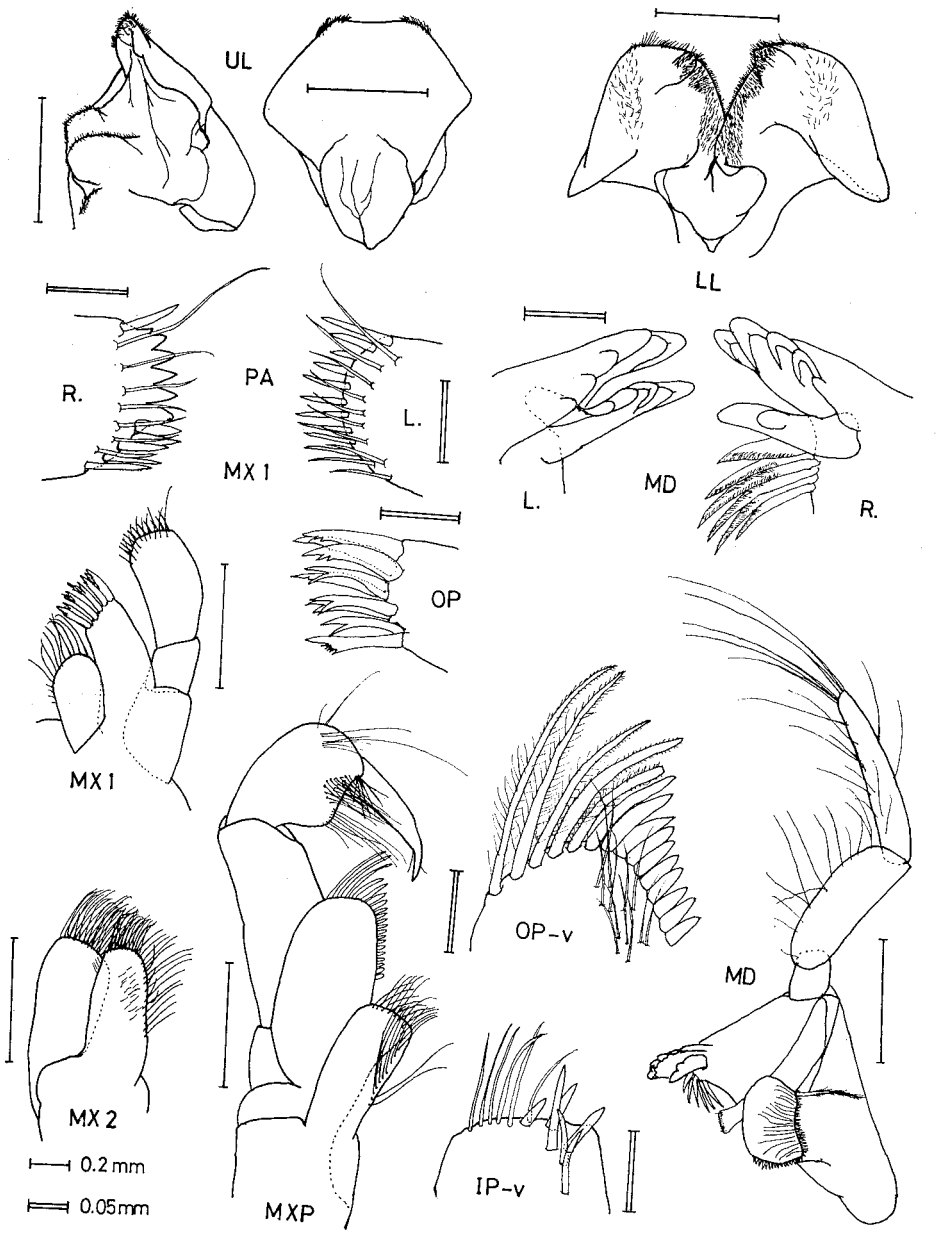

Fig. 2. *Melita rylovae* Bulycheva. Male (2).

but distinct. Telson (Figs 1–T, 6–T): Each lobe with short and long spines at subapical part and marginal spines along both lateral and medial margins.

Female.

Coxa 6 (Fig. 4–CX6): Anterior lobe extending posteriorly, rounded distally, with small projection, with ovoid plate on posterior basal part. Gnathopod 1 (Fig. 4–G1–f): Article 6 with four to six strong subterminal spines along palmar margin. Gnathopod 2 (Fig. 4–G2–f): Palmar corner usually with two long and stout spines,

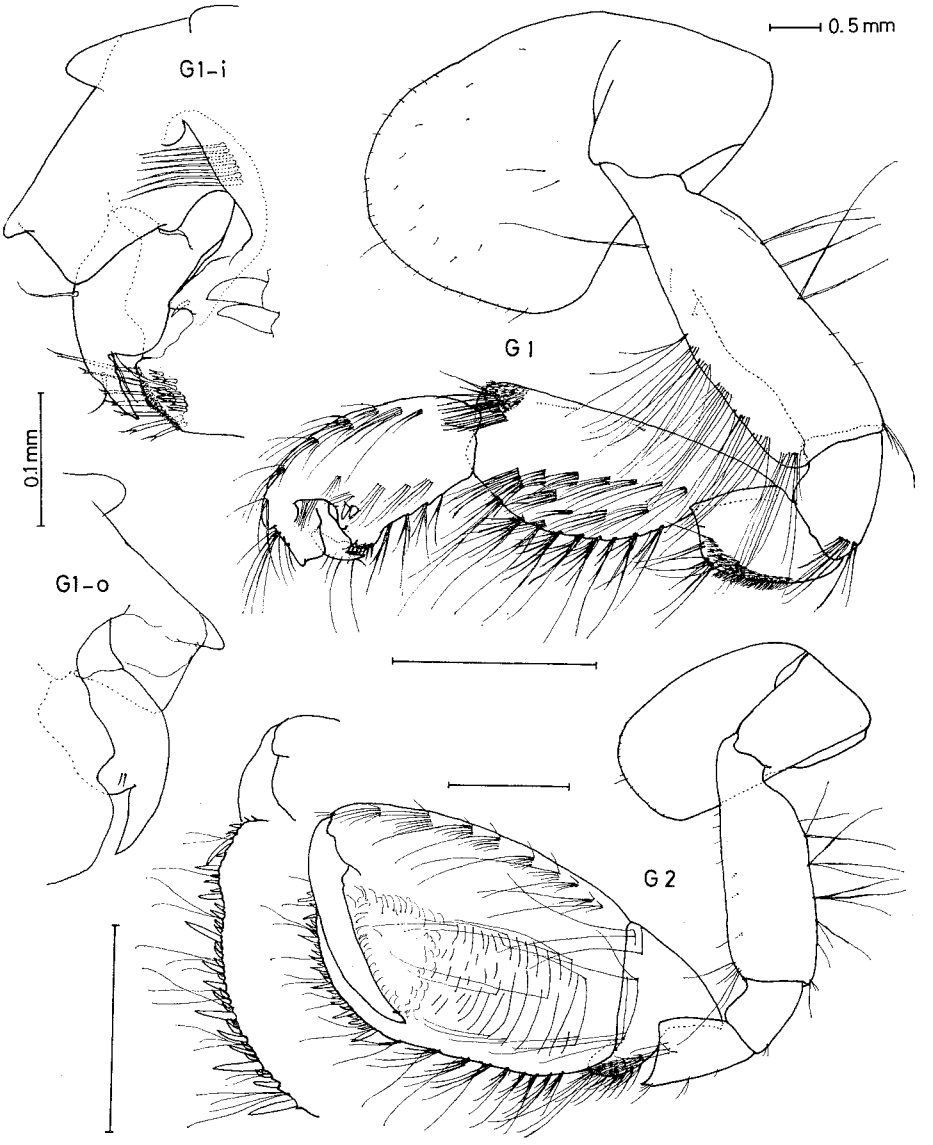

Fig. 3. *Melita rylovae* Bulycheva. Male (2).

but in larger specimens (Fig. 6–G2–f) with three spines.

Habitat: Lower intertidal to upper subtidal, under stones or dead mussels, on muddy substrata or among oysters on the rocks.

Remarks. *Melita rylovae* was originally described by Bulycheva (1955) from the Russian coast of Japan Sea. Later Nagata (1965) synonymized this species with

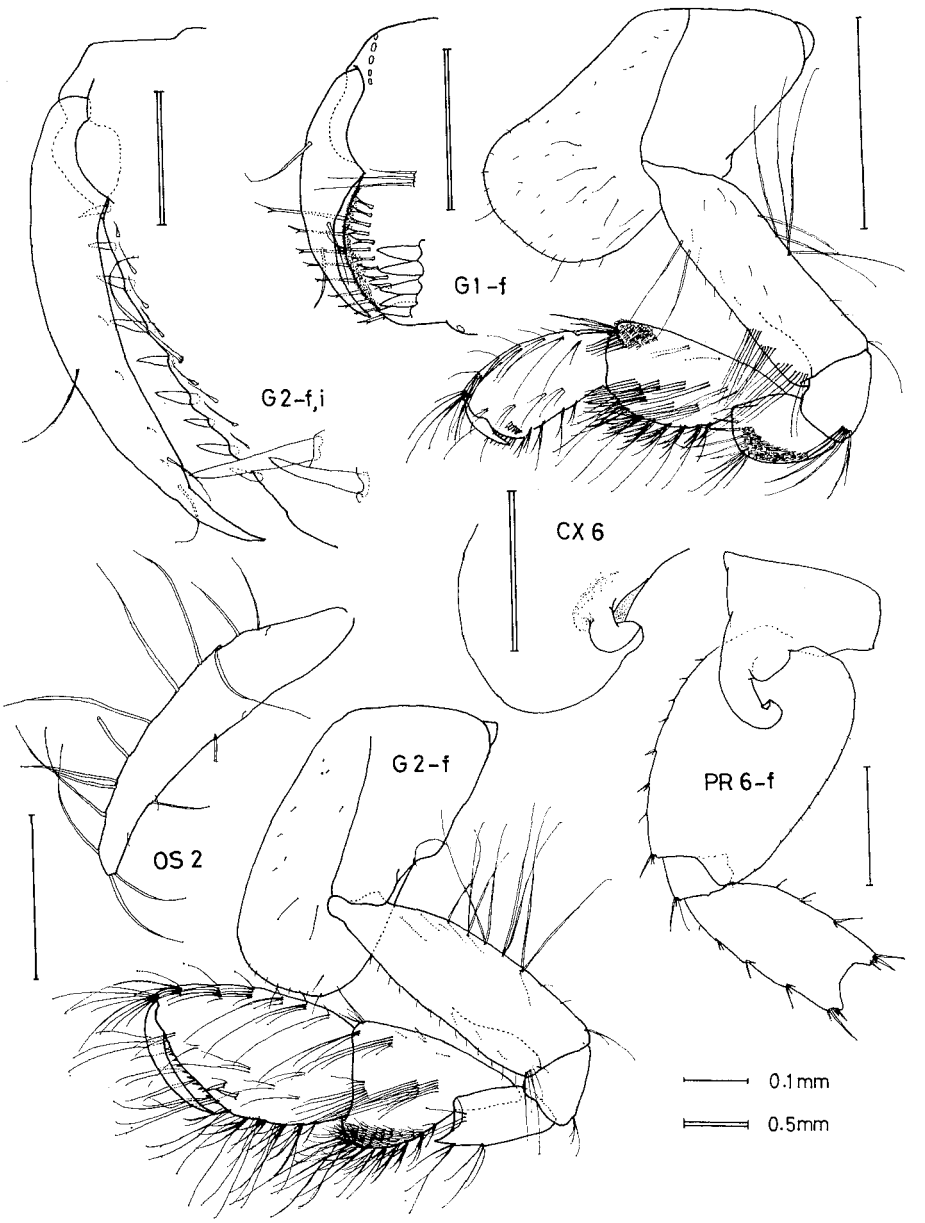

Fig. 4. *Melita rylovae* Bulycheva. Female (1).

Melita koreana Stephensen, because he supposed that *M. rylovae* was actually a fully mature form of *M. koreana*, based upon his observation that there was a continuity between the "*koreana*-form" and the "*rylovae* form". With respect to his observation, I recognized a similar continuity between two "forms" in my specimens, too. However, *M. rylovae* has a distinct characteristic as biarticulation of the uropod 3; this characteristic is not changed through the development. Although the biarticulation of uropod 3 was not mentioned in Bulycheva's description, its short second article was evidently depicted in her figure. On the other hand, *M. koreana* has uni-arti-

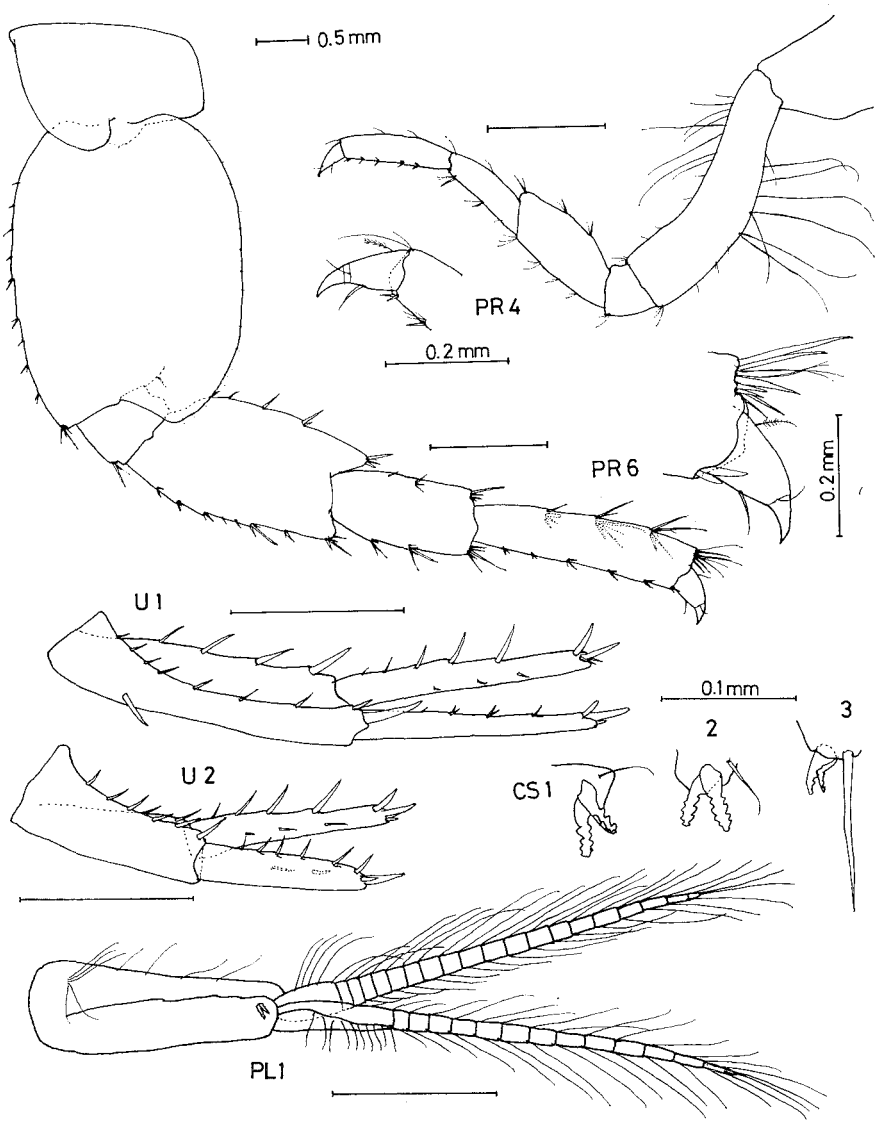

Fig. 5. *Melita rylovae* Bulycheva. Male (2).

culate uropod 3, which bears only three spines at apex in Stephensen's description and which clearly differs from the counterpart in *M. rylovae*. My specimens also agree with Bulycheva's original description in the following peculiar characteristics; broad outer ramus of uropod 3, strongly spinated telson, arch-shaped dorsal teeth of pleosomites, robust article 4 of pereopods 5–7, shapes of gnathopods, and shape of hooked coxa 6 in female.

When Karaman (1981) revised the genus *Melita*, he assigned this species to the genus *Abludomelita*. However, the presence or absence of the oblique row of setae on maxilla 2, which is the sole diagnostic character to discriminate *Melita* and *Abludomelita* in Karaman's classification, has never been reported in this species. Karaman might have determined the generic assignment of this species based upon the biarticulation of uropod 3, which he treated as an auxiliary diagnosis of *Abludomelita*. As described here, the maxilla 2 of this species (Fig. 2–MX2) lacks a dorsal oblique row of setae; therefore, this species must be assigned to the genus *Melita*.

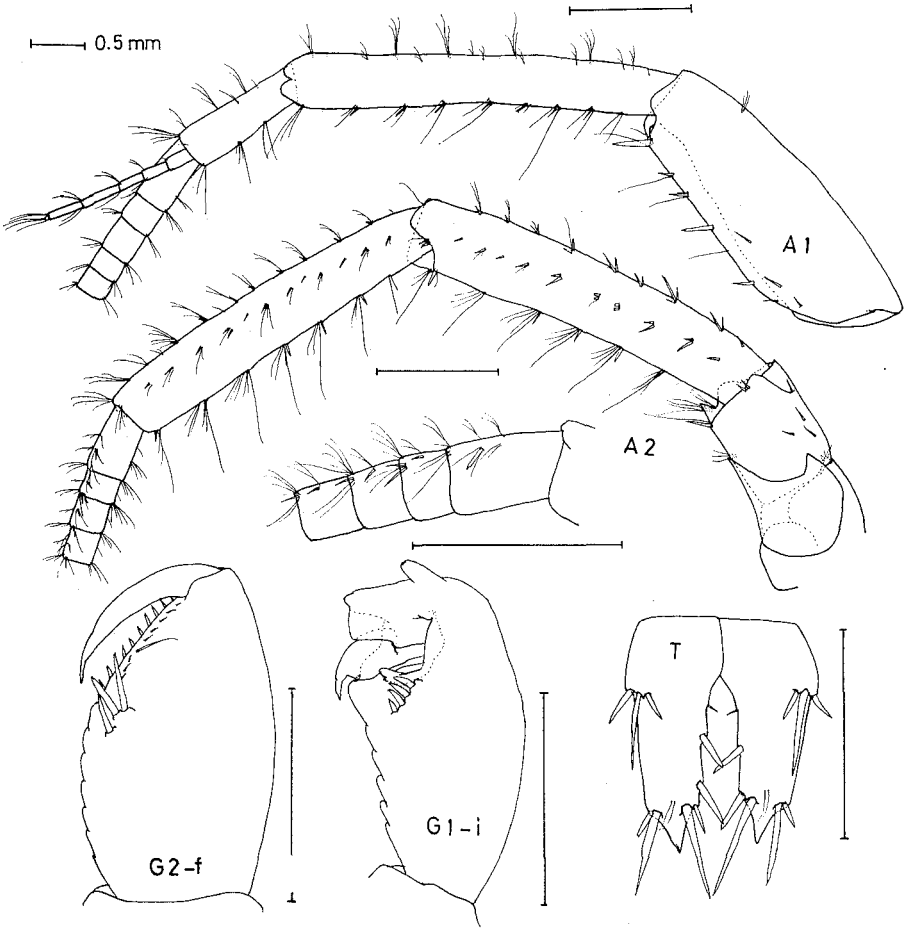

Fig. 6. *Melita rylovae* Bulycheva. Male (3), female (2).

Melita koreana Stephensen, 1944

(Japanese name: kagimerita yokoebi)

(Figs 7–10)

Melita koreana Stephensen, 1944, pp. 39–44, figs 6–8.
Melita koreana: Nagata, 1965, pp. 292–293, (part).

Material examined. Male (1), 5.5 mm; male (2), 6.3 mm; female (1), 5.3 mm (ovigerous), female (2); 4.2 mm (immature); and female (3), 3.8 mm (immature). 6, Oct. 1983, near the MLWN of intertidal zone, under stones, at the front beach of Mukaishima Mar. Biol. St.

Hundreds of specimens from Tomoezaki near Amakusa Mar. Biol. Lab., Kyushu University, 24 Feb. 1985, by Mr. S. Nishihama and Miss C. Aryuthaka.

Male.

Body (Fig. 7): Dorsal side of all the pleonal segments smooth; urosomite 2 with only spines on each side. Epimeral plates 1–3 (Fig. 9–E, 1–3) subround, with minute tooth; epimeral plate 3 with spines along ventral margin.

Antenna 1 (Fig. 8–A1): Pedunuclar article 2 with groups of a spine and setae along ventral margin, groups of setae along dorsal margin; main flagellum up to ca. 30 articles; accessory flagellum up to 4 articles. Antenna 2 (Fig. 8–A2): Peduncular articles 4 and 5 with groups of spines and setae on inner surface and along dorsal margin, and groups of setae along ventral margin; flagellum up to ca. 10-articles. Maxilla 1 (Fig. 8–MX1): First article of palp with lateral setae.

Gnathopod 1 (Fig. 9–G1): Article 6 slightly dilated, with triangular antero-distal lobe, which is slightly convex along lower margin; palmar corner with one

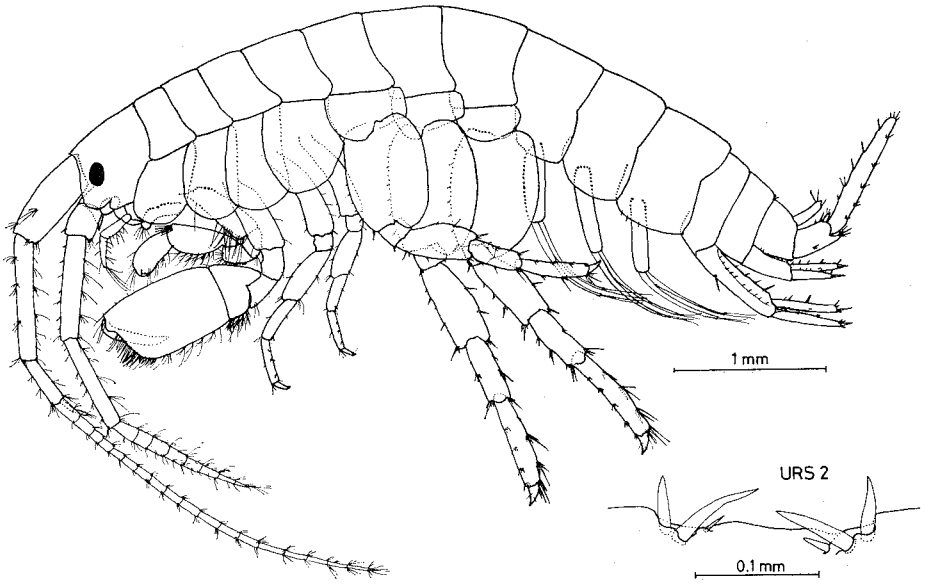

Fig. 7. *Melita koreana* Stephensen. Male (1).

small spine; excavation almost quadrate.

Uropod 3 (Fig. 9–U3): Outer ramus uni-articulate. Telson (Fig. 9–T): Each lobe with two groups of subapical spines, without lateral spines.

Female.

Coxa 6 (Fig. 10–CX6): Anterior lobe slightly curved posteriorly, slightly narrowing apically, with quadrate projection at subapical part.

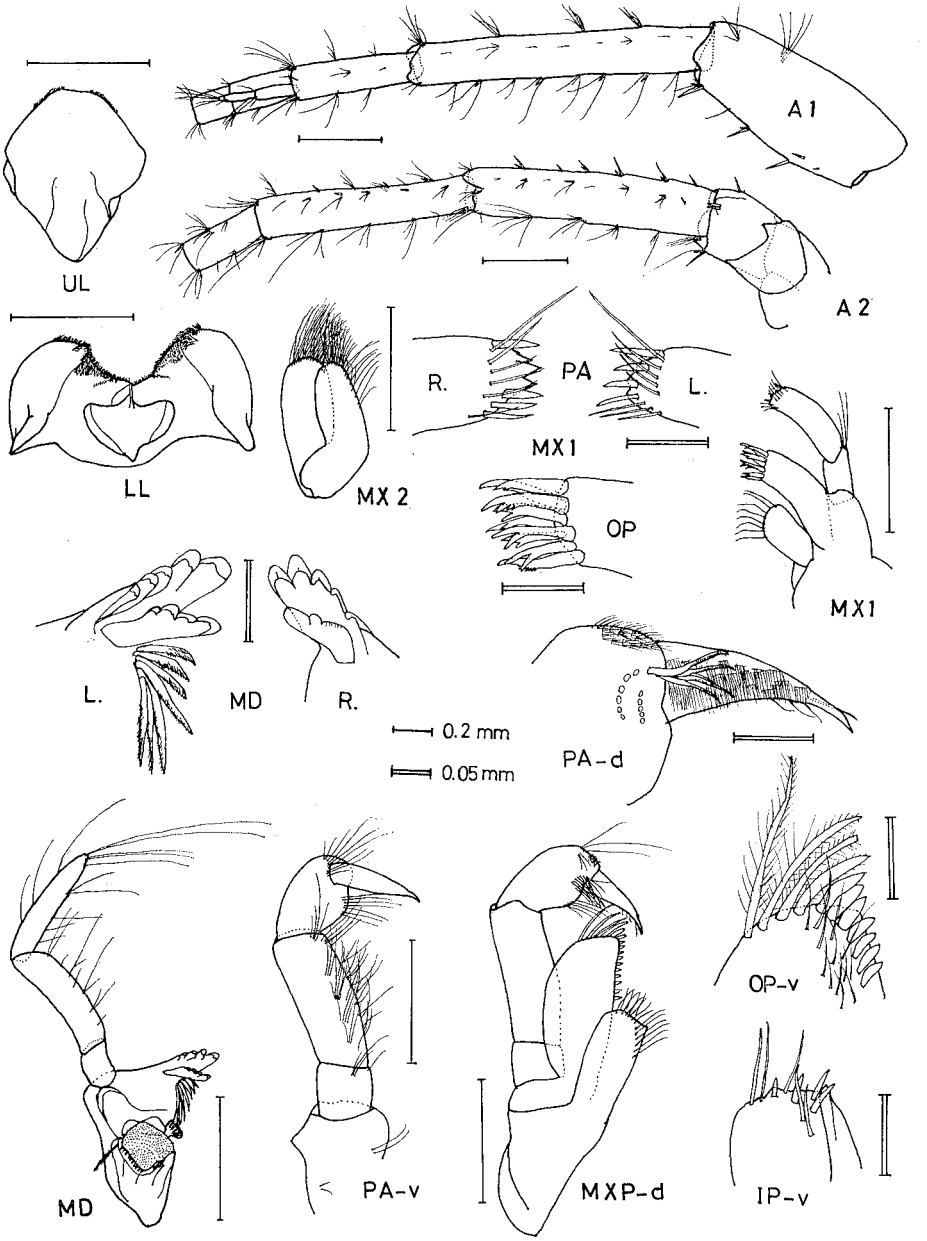

Fig. 8. *Melita koreana* Stephensen. Male (1).

Habitat: Near the MTL of intertidal zone, under stones, on or in coarse sandy substrata.

Remarks. My specimens agree with Stephensen's original description. As Nagata (1965) has already pointed out, Stephensen must have confused the antero-distal lobe of article 6 of male gnathopod 1 with the dactyl. In spite of the confusion,

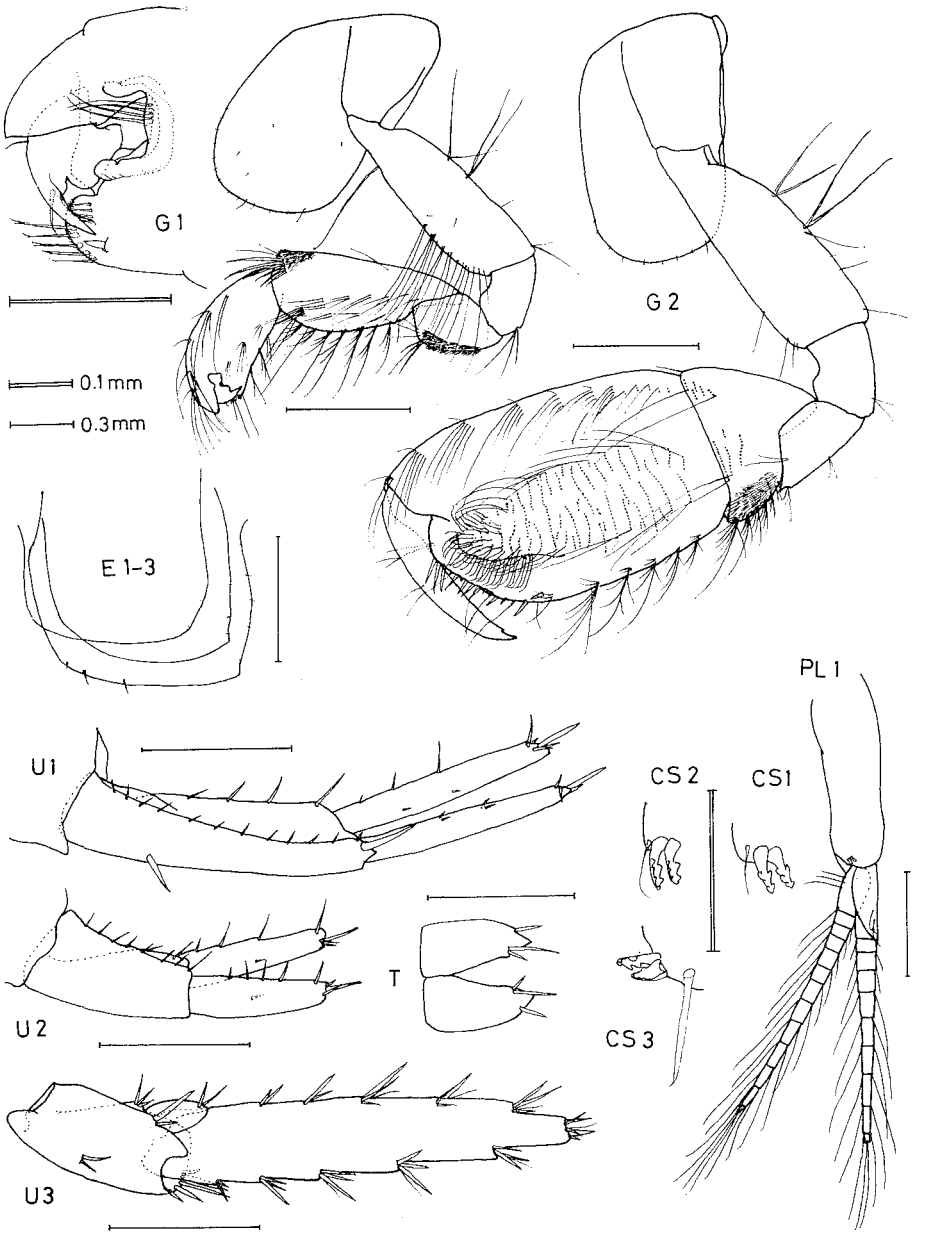

Fig. 9. *Melita koreana* Stephensen. Male (1), PL: Male (2).

the form of the lobe figured by Stephensen, which he mentioned as dactyl, agrees with that of my specimens. The form of the hooked coxa 6 in female also agrees with his figure, in which the projection is small and the distal part is narrow.

Confusion of *Melita rylovae* with *M. koreana* by Nagata (1965) caused the incorrect recognition that some characters of this species were highly variable; for example, laterodorsal tooth on each side of urosomite 2, posterior corner of epimeral plate 3. However, my specimens, which were identified by gnathopod 1 in the male and coxa 6 in the female, well agreed with Stephensen's description in these characters; no dorsal teeth, no teeth on epimeral plate 3. These characteristics are therefore available as diagnostic characters for *M. koreana*.

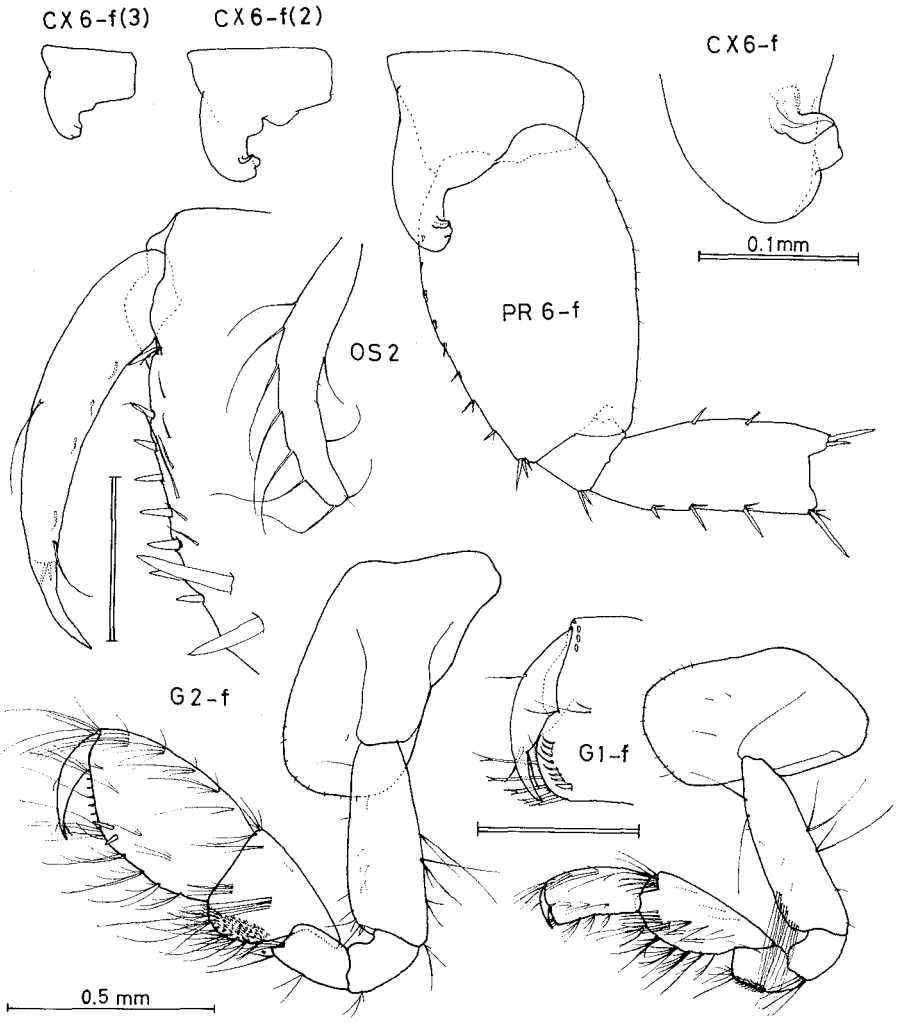

Fig. 10. *Melita koreana* Stephensen. Female (1), Female (2), Female (3).

Melita nagatai n. sp.

(Japanese name: nagatamerita yokoebi, new)

(Figs 11–15)

Material examined. Holotype: Male (1), 6.5 mm, 6 Oct. 1983, near the MLWS of intertidal zone, under stones, at the front beach of Mukaishima Mar. Biol. St. Paratypes (data same as the holotype): Female (1), allotype, 4.9 mm (ovigerous); male (2), 5.0 mm; female (2), 3.5 mm (immature); female (3), 2.7 mm (immature). A male (7.4 mm) and an ovigerous female (6.6 mm) collected on 17 May 1984, from the same locality as the holotype.

Hundreds of specimens from four localities around Amakusa Mar. Biol. Lab., Kyushu University: the front beach of the Laboratory, 20 Dec. 1984, Tomoezaki, 24 Feb. 1985, Tujishima, 2 March 1985, Shioirihama, 24 March 1985, by Mr. S. Nishihama and Ms. C. Aryuthaka. One male from Oshoro, Hokkaido, 28 March 1983, by Mr. S. Ishimaru.

Male.

Body (Fig. 11): Dorsal side of pleosomites 1–3 and urosomites 1 and 3 smooth; dorsal side of urosomite 2 with a minute tooth on each side, which bears spines. Epimeral plates 1–3 (Fig. 4–E1–3) slightly produced ventrodistally, but this tooth reduced in large specimens; epimeral plate 3 with spines along ventral margin, in large specimens epimeral plate 2 also with spines along ventral margin.

Antenna 1 (Fig. 12–A1): Peduncular article 2 with groups of a spine and setae along ventral margin, groups of setae along dorsal margin; main flagellum up to ca. 30 articles (21 articles in holotype); accessory flagellum up to 4 articles (3 articles in holotype). Antenna 2 (Fig. 12–A2): Peduncular articles 4 and 5 with groups of spines and steae on inner surface and along dorsal margin, and groups of setae along ventral margin; flagellum up to ca. 10-articles (8-articles in holotype). Maxilla 1 (Fig. 12–MX1): First article of palp with lateral setae. One seta at

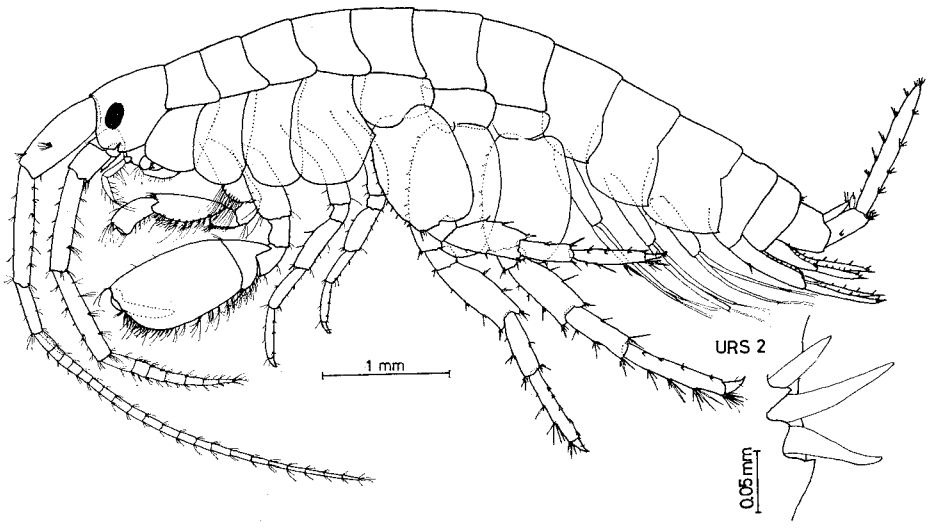

Fig. 11. *Melita nagatai* n. sp. Male (1).

basal part of palp in holotype may be unusual, which was never observed in the other specimens.

Gnathopod 1 (Fig. 13–G1): Article 6 slightly dilated; anterodistal lobe triangular, acute distally, slightly concave along lower margin of the lobe; palmar corner with one small spine; excavation trapezoidal, which forms an acute angle

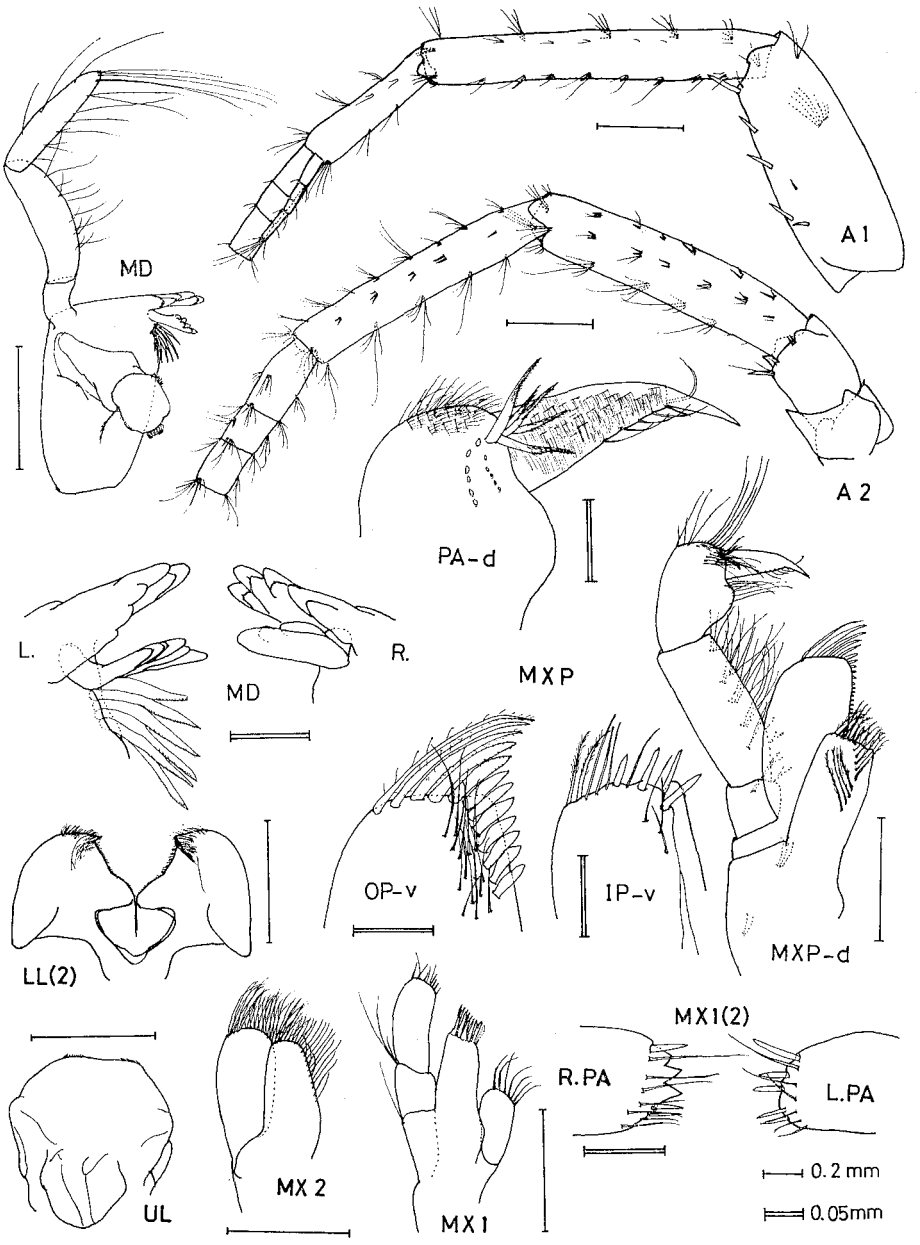

Fig. 12. *Melita nagatai* n. sp. Male (1), male (2).

dorsally; inner surface above the excavation slightly swollen. Dactyl strongly bulging. Gnathopod 2 (Fig. 13–G2): Palmar spines composed of long thin spines. Pereopods 5–7: Article 4 slender.

Uropod 3 (Fig. 15–U3): Outer ramus slender, slightly tapered distally, uniarticulate. Telson (Fig. 15–T): Each lobe with two groups of subapical spines, without lateral spines.

Female.

Coxa 6 (Fig. 14–CX6): Anterior lobe slightly curved posteriorly, with broad projection, which swells strongly at basal part.

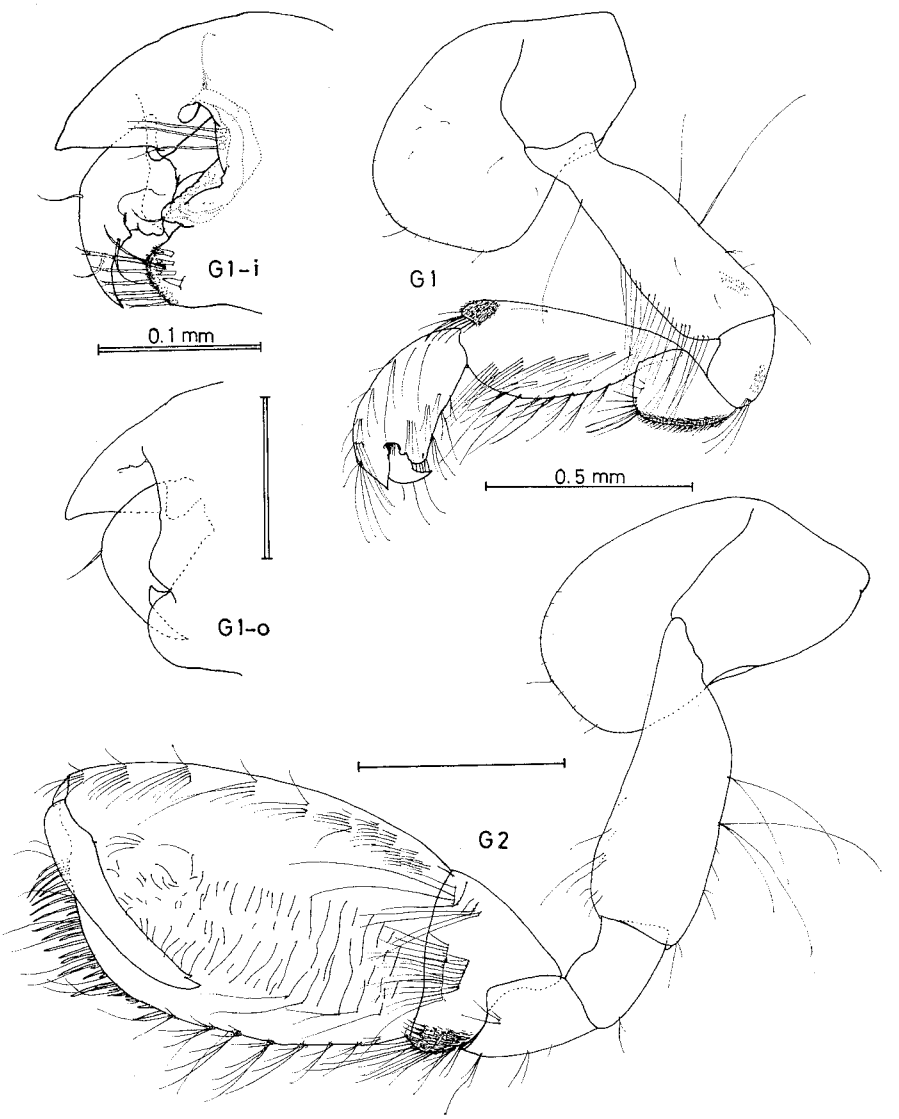

Fig. 13. *Melita nagatai* n. sp. Male (1).

Habitat: Near the lower intertidal zone, under stones or dead mussels on muddy substrata.

Etymology: The specific name is in honor of Dr. Nagata whose pioneering work on the taxonomy of amphipods in Japan made me initiate this study.

Remarks. This new species closely resembles *Melita koreana* but can be discriminated from the latter by the distally acuted anterodistal lobe and trapezoidal excavation of article 6 of male gnathopod 1, and by the broader and stronger projection of female coxa 6. The new species is also discernible from *M. koreana* in minor characteristics such as slender body form, the slightly smaller body size, the slightly toothed urosomite 2, and the slightly acuting epimeral plate 3. But these minor differences are not always available for identification because of the intergradation in and between these two species.

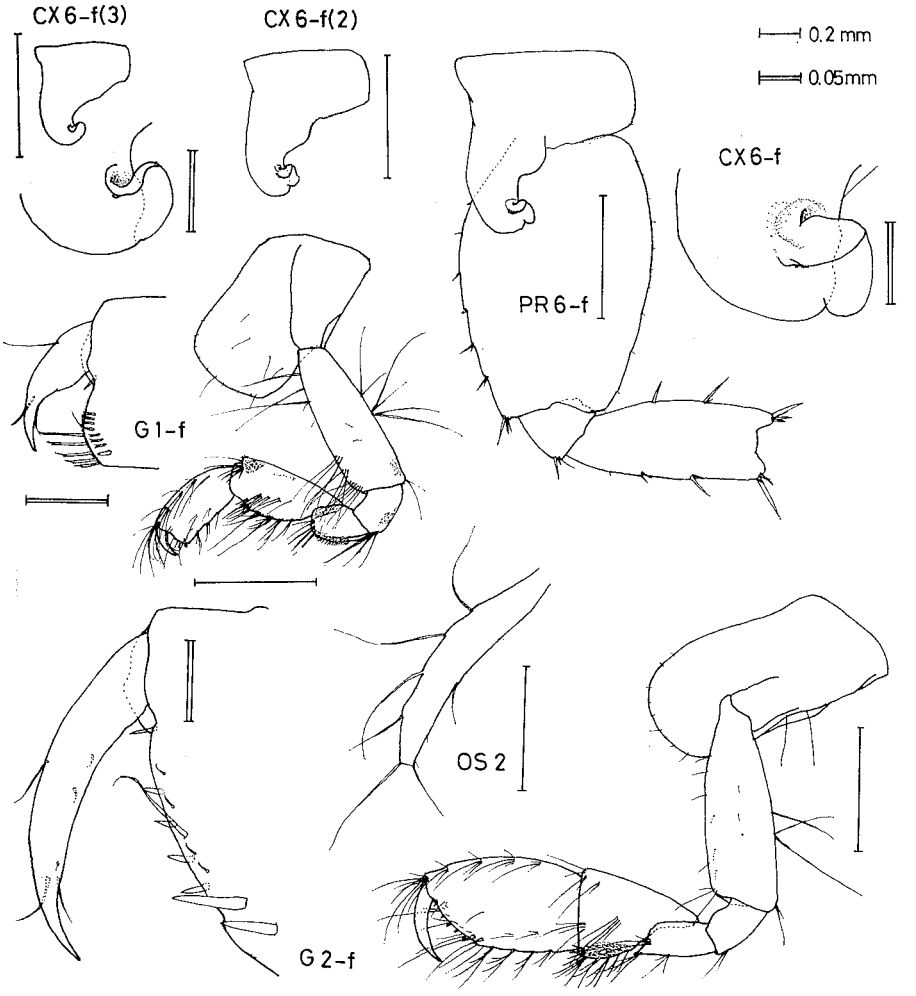

Fig. 14. *Melita nagatai* n. sp. Female (1), female (2), female (3).

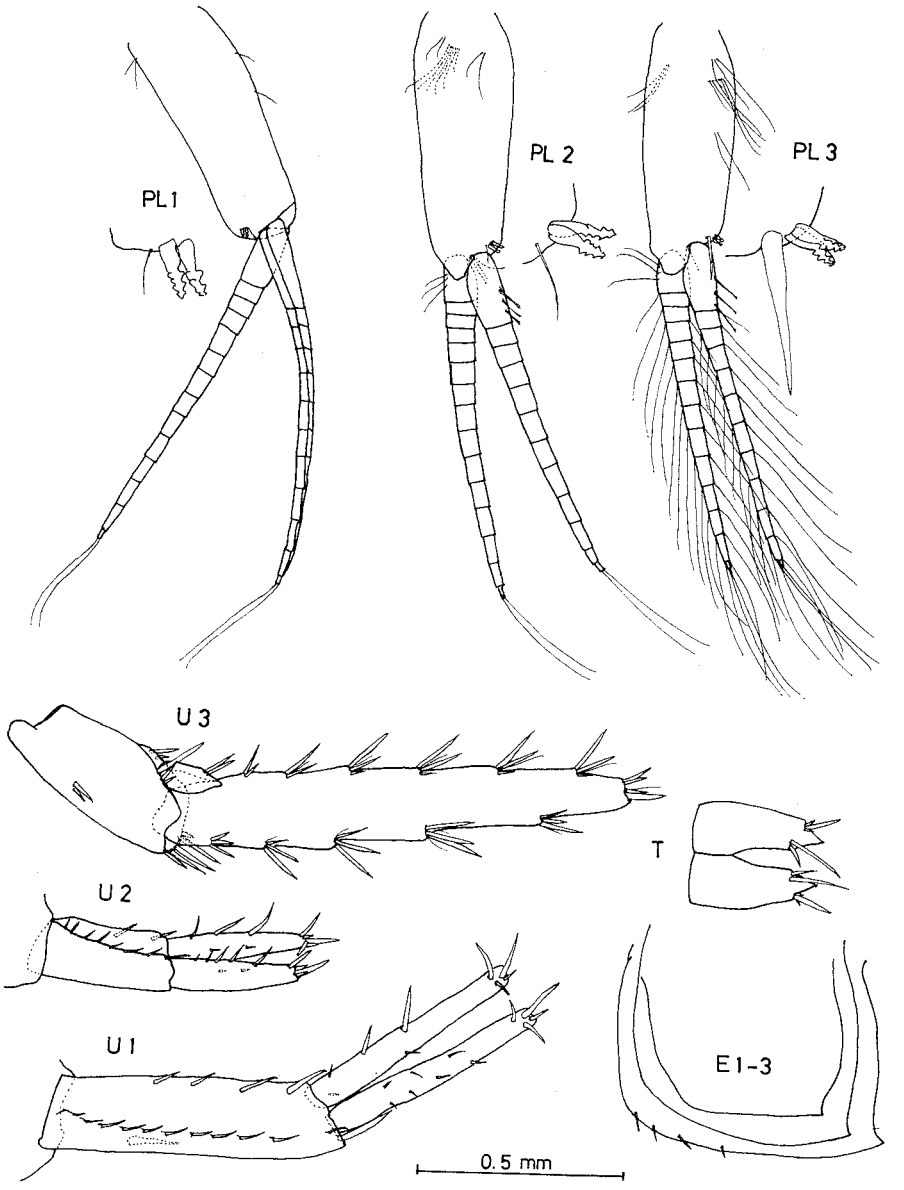

Fig. 15. *Melita nagatai* n. sp. Male (1).

***Melita bingoensis* n. sp.**

(Japanese name: bingomerita yokoebi, new)

(Figs 16–20)

Material examined. Holotype: Male (1), 4.9 mm, 6 Oct. 1983. near the MTL of intertidal zone, under stones, at the front beach of Mukaishima Mar. Biol. St. Paratypes (data same as the holotype): Female (1), allotype, 4.3 mm (ovigerous); female (2), 3.3 mm (immature); female (3),

2.6 mm (immature). Male (2), 6.9 mm and an ovigerous female (6.3 mm), 17 May 1984, from the same locality as the holotype.

Male.

Body (Fig. 16): Dorsal side of pleosomites 1–3 and urosomites 1 and 3 smooth; dorsal side of urosomite 2 with a distinct small tooth on each side, which bears spines. Epimeral plates 1–2 almost subround, with distinct tooth ventrodistally; epimeral plate 3 distinctly produced ventrodistally.

Antenna 1 (Fig. 20–A1): Peduncular article 2 with groups of setae along ventral and dorsal margins, without spines; main flagellum up to ca. 25 articles (19-articles in holotype); accessory flagellum up to 3 articles (2 articles in holotype). Antenna 2: Peduncular article 4 with groups of spines and setae on inner surface and along dorsal margin. Peduncular article 5 with groups of setae on inner surface and along dorsal and ventral margins, without spines; in large specimens (Fig. 20–A2) inner surface with several spines. Flagellum up to ca. 10 articles (8 articles in holotype). Mandible (Fig. 17–MD): Article 3 of palp with only one seta on dorsal margin. Maxilla 1: First article of palp with lateral setae.

Gnathopod 1 (Fig. 18–G1): Article 6 not dilated distally, with ordinally one strong spine (in holotype left gnathopod 1 with two spines) on inner surface; anterodistal lobe small, triangular; excavation narrow. Gnathopod 2 (Fig. 18–G1): Palmar spines composed of long thin spines.

Uropod 3 (Fig. 20–U3): Outer ramus slender, uni-articulate, Telson (Fig. 20–T): Both lobes with two groups of subapical spines; in large specimens (Fig. 20–T (2)) with lateral spines along medial margin.

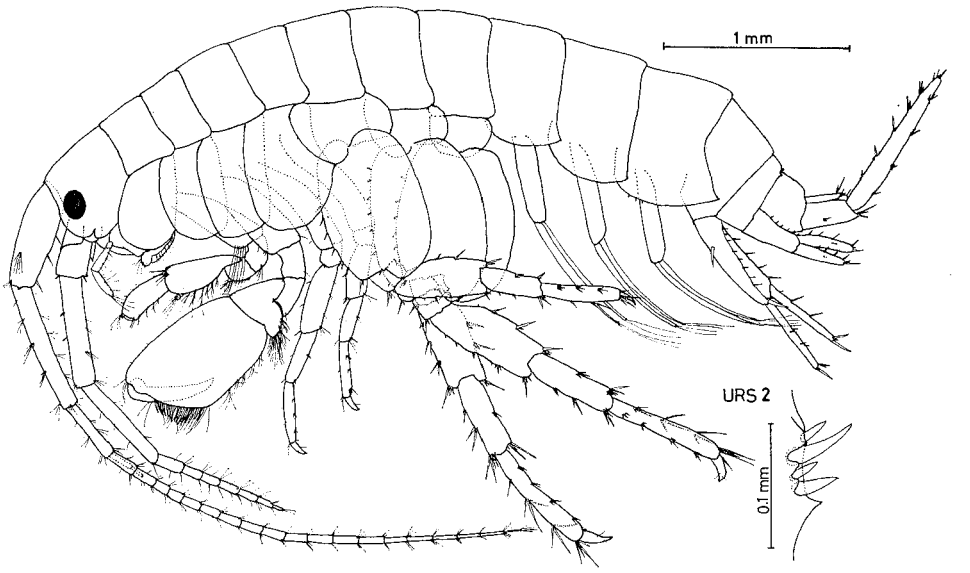

Fig. 16. *Melita bingoensis* n. sp. Male (1).

Female.

Coxa 6 (Fig. 19–CX6): Anterior lobe extending posteriorly, slightly tapered distally; basal part with one slit-like shallow "pocket". Gnathopod 2 (Fig. 19–G2): Spination along palmar margin weak.

Habitat: Upper to middle part of intertidal zone, places affected by the inflow of freshwater or innermost parts of coves.

Etymology: This species has been collected at the present only around Mukaishima Island and Matsunaga Bay, eastern part of Hiroshima Prefecture which was formerly referred to Bingo.

Remarks. This new species resembles *M. koreana* and *M. nagatai*, but can be discriminated from the two species by the shapes of male gnathopod 1 and female coxa

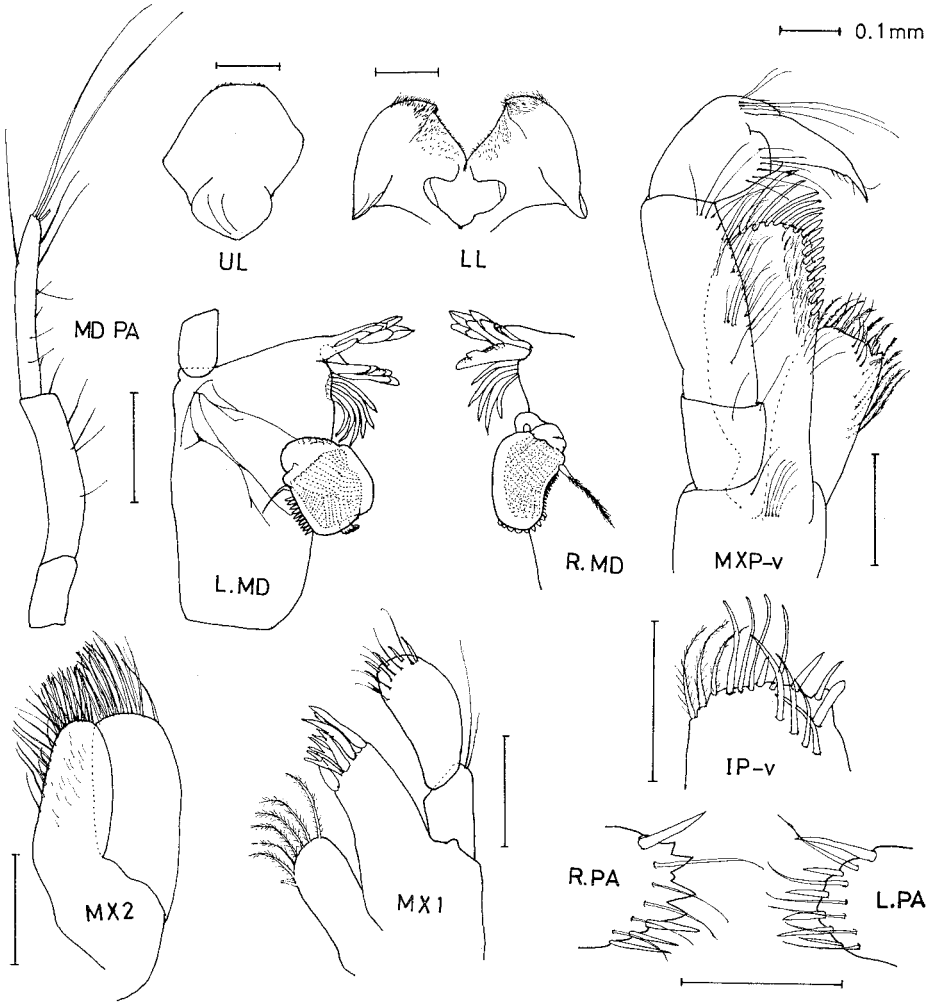

Fig. 17. *Melita bingoensis* n. sp. Male (1).

6. This species has also minor characteristics: epimeral plate 3 rather distinctly produced ventrodistally; dorsal side of urosomite 2 rather distinctly toothed; telson bearing lateral spines in large specimens; and weak spination of antennae; weak setation of dorsal side of mandible palp.

At first sight, the shapes of hooked coxa 6 in female and gnathopod 1 in male

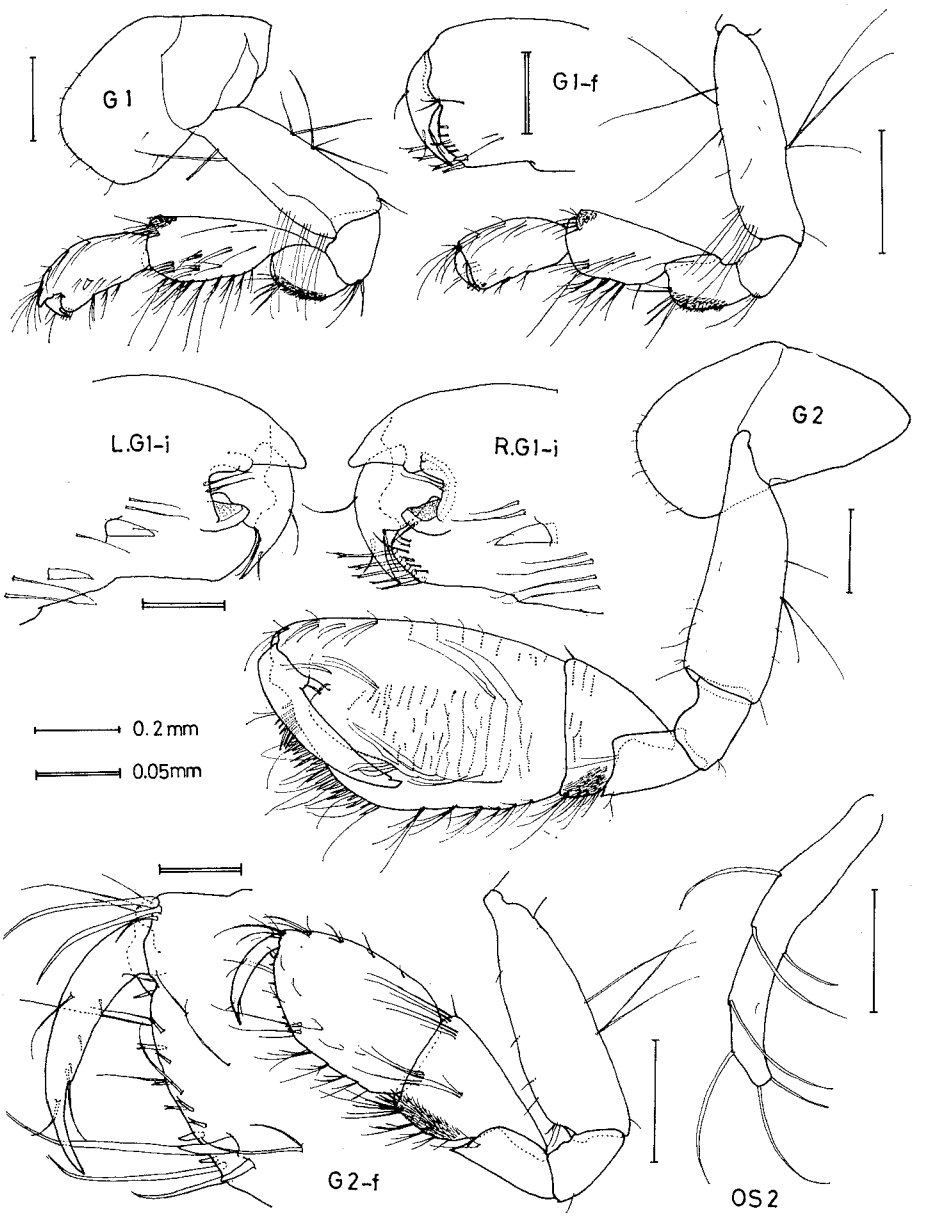

Fig. 18. *Melita bingoensis* n. sp. Male (1), female (1).

of this species seemed to be very similar to counterparts in *Melita zeylanica* Stebbing, 1904 from Ceylon, so I examined the syntype series of specimens of the latter species and found that the minute structures of those characters are different between two species; *M. zeylanica* has no stout spines on article 6 of male gnathopod 1, no slit-like "pockets" on female coxa 6, and swollen quadrate lobe on posterior basal part of hooked process of female coxa 6. *Melita zeylanica* is also different from this new species in the robust article 4 of pereopods 5–7 and relatively short antenna 1 which is slightly longer than antenna 2.

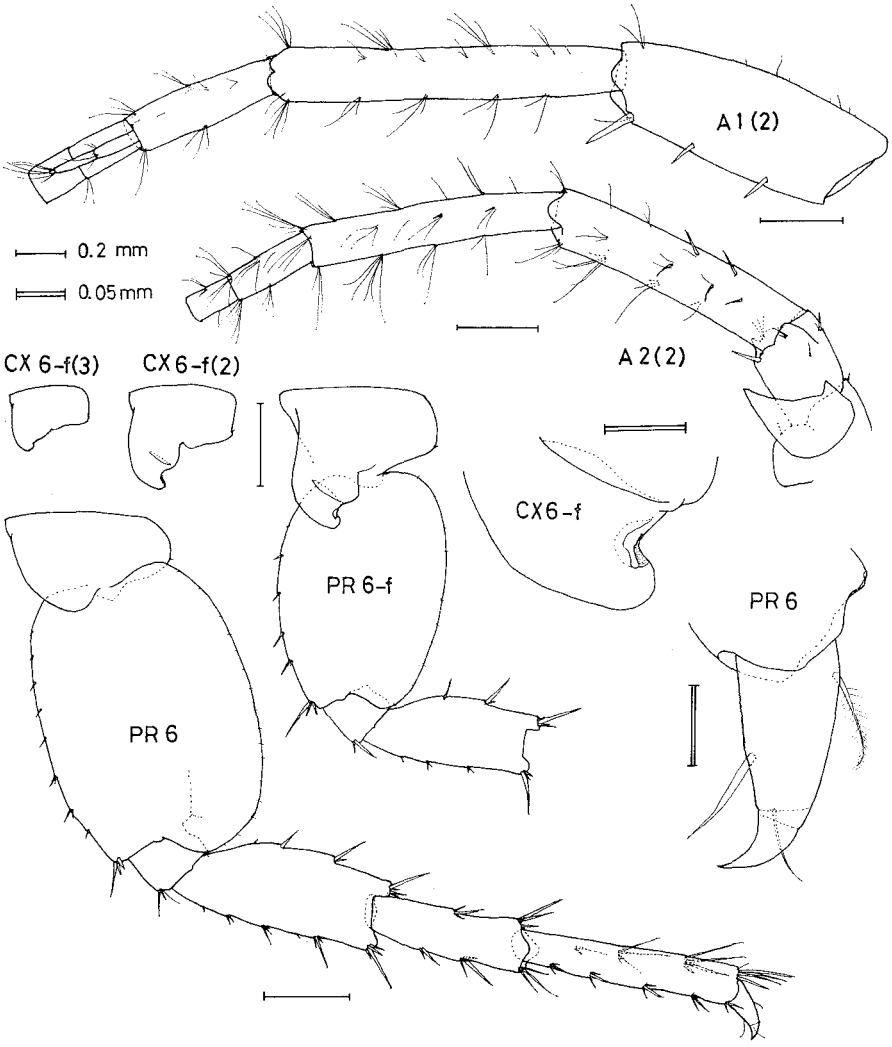

Fig. 19. *Melita bingoensis* n. sp. Male (1), A1, A2: Male (2), female (1), female (2), female (3).

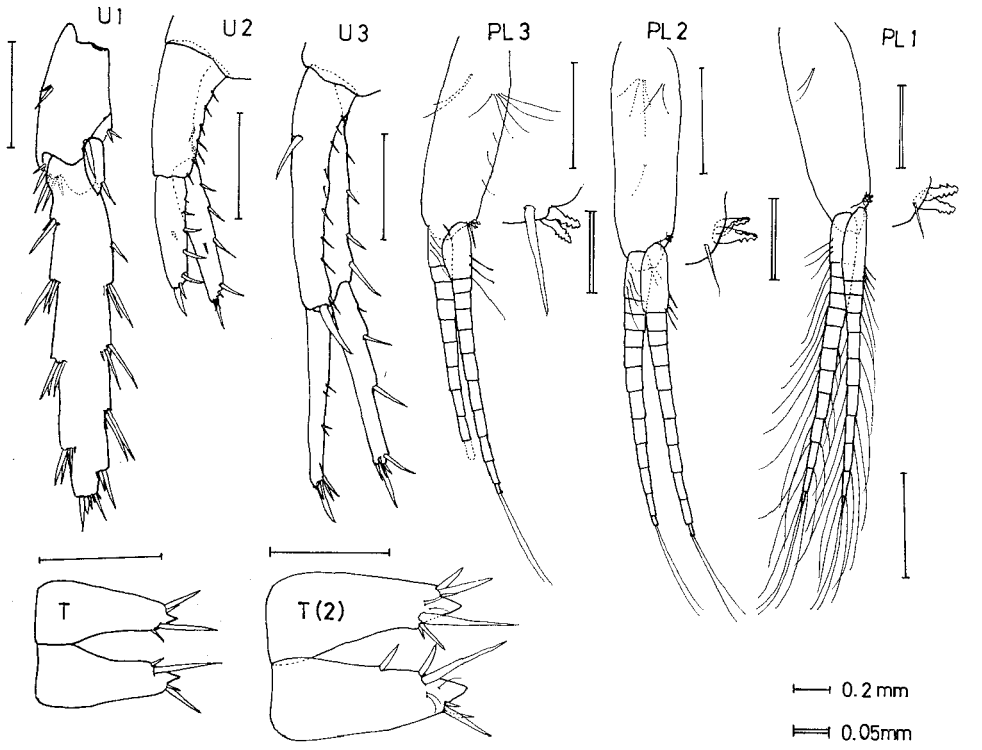

Fig. 20. *Melita bingoensis* n. sp. Male (1), male (2).

Discussion

Among the four species treated here, *M. rylovae* has distinct characteristics; biarticulate and broad outer ramus of uropod 3, spination of telson, arch-shaped dorsal teeth of pleosomites 1–3, and absence of lateral setae on palp of maxilla 1. Because biarticulation of uropod 3 is stable through ontogeny, this species can be discriminated in every stage even from a mixed sample of these species. In spite of these peculiarities, *M. rylovae* closely resembles the other three species in each appendage. These four species seem to be included with a certain related group.

The three species except *M. rylovae* can be discriminated from one another only by the shape of coxa 6 in females and gnathopod 1 in males, represented as sexually dimorphic characters. They cannot be distinguished in juvenile stages. Nevertheless, as far as adults are concerned, the four species are distinct and there are no intermediate forms in female coxa 6 and male gnathopod 1.

The diagnostic value of hooked coxa 6 in females has been referred mainly to whether it is hooked or not-hooked, and has been rarely referred to its detailed shape. It seems to be a general tendency that the species which have hooked coxa 6 in females also have "aberrant gnathopod 1" in males or the complex of excavated propod and bulging dactyl in male gnathopod 1; up to the present more than 15 hooked species have been reported, and in most of these species the male gnathopod 1 is

quite or somewhat aberrant. These appendages are used during the reproductive behavior or precopulation, as reported in *Melita nitida* (Borowsky, 1984) and *Melita zeylanica* (Krishnan & John, 1974). The four species treated here also show the behavior that the male uses gnathopod 1 for carrying the female, clinging to her hooked coxa 6 (unpublished). Although these behavioral patterns might be polyphyletic, the shape of male gnathopod 1 and female coxa 6 as sexual dimorphisms are clearly different among species and are of certain value as a specific character.

Since Stebbing's monograph, there has been a tendency to use the ornamentation of pleonal segments as a key character of melitid species, and then some authors tabulated "pleonal tooth formulas" (Stephensen, 1944; Barnard, 1962). Barnard (1962) divided 38 species of the genus *Melita* at that time into three major keys based upon the formulas: Key A, bearing no dorsal pleonal teeth; Key B, dorsal pleonal teeth only on urosome; Key C, dorsal pleonal teeth on both pleosome and urosome. Later authors have been more or less following Barnard's keys, and Sheridan (1979) presented a new key to the species in the Key A or of his "Group A". However, as Barnard (1962) mentioned, these teeth have been inexactly described and have been confounded with various dorsal processes. Among the four species treated here only *M. rylovae* has dorsal teeth on both pleosomites and urosomites, but its arch-shaped teeth on pleosomites is essentially different from the medial dorsal teeth which are shared with most of the species in the Key C. At the same time, lateral teeth on urosomite 2 intergradationally appear among the four species: *Melita rylovae* with distinct teeth appearing in early developmental stage, *M. nagatai* and *M. bingoensis* with small teeth appearing only in large specimens, and *M. koreana* without any distinct teeth throughout ontogeny. Thus, dorsal tooth formulas of these four species make Barnard's key obscure. Although I recognize the usefulness of pleonal tooth formulas as a key character, the sole dependence in the melitid taxonomy upon the teeth must have caused some of former taxonomists to overlook the real relationship and other differences.

When Karaman (1981) split the genus *Melita* into *Melita* (s. str.) and *Abludomelita,* he based it mainly upon the absence or presence of the dorsal oblique row of setae on maxilla 2 and auxiliary upon the absence or presence of second article of uropod 3, and did not refer to the pleonal tooth formulas, "aberrant gnathopod 1", and hooked coxa 6. However, most of the strongly toothed species, or most of the species in Barnard's Key C, above mentioned, were unintentionally excluded from the genus *Melita* in his classification. On the other hand, species with hooked coxa 6 and "aberrant gnathopod 1" is allocated in both *Melita* and *Abludomelita.* Karaman's splitting is probably right in the light of the correlation between the setation of maxilla 2 and the pleonal tooth formula, but both *Melita* and *Abludomelita* seem to be still not homogeneous. More characters and correlation of characters should be considered and summarized in a consistent way, in order to complete the revision of this group.

The posterior margin of epimeral plate 3, like lateral dorsal teeth of urosomite 2, is subtly different but show intergradation among the four species: distinctly

produced posteriorly in *M. rylovae*, slightly produced in *M. bingoensis* and *M. nagatai*, and not produced in *M. koreana*. Moreover, in larger specimens of *M. nagatai* the projection is reduced, and in smaller specimens of *M. koreana* the small projection exists. This character has a restricted availability for discriminating the four species.

There are the other minute and quantitative differences among the four species. For example, the four species are different in the body size of terminal adults; *M. rylovae* is the largest, and *M. koreana*, *M. nagatai* and *M. bingoensis* in order of decreasing size. It is probable that the spination and setation of every appendage and the articulation of antennae become stronger with larger body size. The robustness of pereopods 5–7 and the broadness of uropod 3 seem to be related to the body form of each species; *M. rylovae* is very robust and *M. nagatai* is very slender.

These four species are related to following species of the genus *Melita*, which share such distinct characters as "*palmata*-like" gnathopod 2, or setaceous propods of male gnathopod 2 in males, "aberrant gnathopod 1" in males, and hooked coxa 6 in females; *M. zeylanica* Stebbing, 1904 from, Ceylon, *M. z. kauerti* Barnard, 1972, from Australia, *M. pahuwai* Barnard, 1970, from Hawaii, *M. nitidula* Ruffo, 1958, from Madagascar, *M. orgasmos* Barnard, 1940, from South Africa, *M. cerelicula* Croker, 1974, from Micronesia, *M. inaequistylis* (Dana, 1852), from New Zealand. Up to the present, these species have been characterized by the following points: *M. zeylanica* has robust article 4 of pereopods 5–7; *M. pahuwai* has stout palmar spines on gnathopod 1 and the strongly spinated telson; *M. nitidula* has a juvenile type of morphology; *M. orgasmos* and *M. cerelicula* have a medial tooth on urosomite 1; *M. inaequistylis* has a pair of two teeth, embracing a spine on urosomite 2, and biarticulate uropod 3. But these characteristics are not necessarily clear-cut and are occasionally shared by other species; therefore, these species should not be identified using only a single character.

These species are so similar that some confusions are seen. Some of them, i.e. *M. inaequistylis*, *M. zeylanica* and *M. orgasmos*, had been synonymized to and regarded as a single species, *M. inaequistylis* (see J.L. Barnard, 1972b). Furthermore, some forms previously reported under the name of *M. zeylanica* may be different from Stebbing's specimens. For example, Sivaprakasam's (1966) description of the species from India is different from the original one in the dilated article 6 of gnathopod 1 and the setation of maxilla 1 palp and mandible palp article 3. Barnard's (1972) subspecies *M. z. kauerti* is very different from *M. zeylanica* in the setaceous uropod 3 and the shape of coxa 6. Meyer's (1985) description based upon materials from Fiji is different in the shape of female coxa 6 and slender body form.

In the case of discriminating these similar species, including the four species treated in this paper, the detailed description on the shape of male gnathopod 1 and female coxa 6 are effective and inevitable. Although these detailed shapes are not figured for all the species, in figured ones they are clearly different one another. Therefore, the precise description of these characteristics would settle some problems on the identification of the genus *Melita*.

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